

AMENDMENTS TO THE CLAIMS

LISTING OF CLAIMS:

1. (Currently Amended) An absolute position rotary encoding apparatus comprising:
a disk having a first code track and a second code track formed on said disk;
a light source for illuminating said code tracks;
a first area array sensor, comprising a pixel matrix having a plurality of rows,
configured to receive the light illuminating said code tracks for forming an imaged
pattern of a portion of said first and second code tracks simultaneously,
the encoding apparatus being operative to;~~said area array sensor capable of~~
~~imaging onto a pixel matrix having a plurality of rows;~~
read a first detector line~~reading a first detector line~~ corresponding to a row in the
pixel matrix comprising the imaged pattern of the first code track;
read a second detector line~~reading a second detector line~~ corresponding to a row in
the pixel matrix comprising the imaged pattern of the second code track; ~~and~~
compensate a processor compensating for fluctuations in the code ~~track~~tracks,
resulting from the disk being inaccurately mounted, by dynamically shifting at least one
of said detector lines on the first area array sensor being read, such that a period length of
the imaged pattern along said at least one detector line remains constant; and
~~- of the code tracks matches a period length used in the position calculation and~~
~~for numerically calculate~~ calculating an absolute position based on the imaged code
tracks from the disk.
2. (Previously Presented) An encoding apparatus according to claim 1, wherein the
disk is an optical disk suitable for use in a rotary encoder and the first code track
represents the incremental track and the second code track represents the absolute track.
3. (Previously Presented) An encoding apparatus according to claim 1, wherein said
light source is a photoemitter such as an LED, laser diode, or incandescent light source.

4. (Currently Amended) An encoding apparatus according to claim 1, wherein the first area array sensor is constructed of either CCD or CMOS photodiode technology.
5. (Previously Presented) An encoding apparatus according to claim 1, wherein said light source and said first area array sensor are proximally located on a first side of the disk and a mirror located on a second side, whereby the emitted light is reflected by the mirror through the disk to illuminate the code tracks for reception by the first area array sensor.
6. (Currently Amended) An encoding apparatus according to claim 1, ~~wherein the processor includes~~ further including a Field Programmable Gate Array (FPGA) logic circuit for numerically calculating phase intensity distribution, spatial frequency and the phase angle of the imaged pattern of the code tracks.
7. (Currently Amended) An encoding apparatus according to claim 2, further comprising a second area array sensor, ~~where~~ wherein the first area array sensor and the second area array sensor are positioned 180 degrees apart with respect to the optical disk, such that the incremental and absolute code tracks are read at two different locations resulting in two different angular positions, and wherein the absolute position is based on the mean of the angular positions.
8. (Original) An encoding apparatus according to claim 2, wherein the incremental track is comprised of a plurality of equally spaced and radially distributed markings near the outer edge of the disk, and wherein the absolute track is comprised of markings that form a series of coded lines that include broad and narrow lines radially distributed inside the incremental track such that the broad lines divide the track into equally sized sections and within each section are two narrow data lines that carry information about absolute position.
- 9.-10. (Cancelled)

11. (Currently Amended) An encoding apparatus according to claim 2, further comprising third and fourth area array sensors ~~are~~ positioned 90 degrees apart with respect to the optical disk, such that the incremental and absolute code tracks are read at four different locations.

12. (Currently Amended) A Total Station theodolite apparatus used for topographic surveying and mapping includes an optical encoder for measuring angular position in the vertical plane and the horizontal plane and cooperates with a servo-mechanism for automatically tracking a target, said encoder comprising:

an optical disk having an incremental code track and an absolute code track formed thereon;

a photoemitter light source for illuminating ~~the incremental and absolute~~ said code tracks;

a first area array ~~sensor~~ sensor, comprising a pixel matrix having a plurality of rows, configured to receive the light illuminating said code tracks for forming an imaged pattern of a portion of said incremental and absolute code tracks ~~from the disk~~ simultaneously,

the encoder being operative to:

~~said first area array sensor being capable imaging onto a pixel matrix having a plurality of rows;~~

~~a first detector reading~~ read a first detector line corresponding to a row in the pixel matrix comprising ~~the incremental track;~~

~~a second detector reading a second detector line corresponding to a row in the pixel matrix including the absolute~~ imaged pattern of the incremental code track; and

read a second detector line corresponding to a row in the pixel matrix comprising the imaged pattern of the absolute code track;

compensate for fluctuations in the code tracks, resulting from the disk being inaccurately mounted, by dynamically shifting at least one of said detector lines on the area array sensor being read, such that a period length of the imaged pattern along said at least one detector line remains constant;

~~a processor for compensating for a shifting code track resulting from inaccurate mounting of the disk by selecting a suitable line imaged by the area array sensor such that a period length of the imaged pattern of the code tracks matches a period length used in a position calculation, calculating~~

~~numerically calculate~~ an absolute position based on the imaged code tracks from the ~~disk, disk;~~ and

~~calculate~~~~calculating~~ topographic data and tracking information about the target.

13. (Currently Amended) A Total Station apparatus according to claim 12, wherein the optical disk is opaque with transparent markings defining the incremental and absolute code or is a transparent disk with opaque markings defining the incremental and absolute code tracks.

14. (Currently Amended) A Total Station apparatus according to claim 12, wherein the photoemitter light source is an LED, laser diode, or incandescent light source and the first area array sensor is an Interline Transfer (ILT) CCD area array sensor.

15. (Currently Amended) A Total Station apparatus according to claim 12, wherein the ~~processor~~encoder further includes a Field Programmable Gate Array (FPGA) logic circuit for numerically calculating ~~the~~ phase intensity distribution, the spatial frequency and the phase angle of the ~~image~~imaged pattern of the code tracks.

16. (Previously Presented) A Total Station apparatus according to claim 12, further comprising a second area array sensor, wherein the first area array sensor and the second area array sensor are positioned 180 degrees apart with respect to the optical disk, such that the incremental and absolute code tracks are read at two different locations resulting in two different angular positions, and wherein the absolute position is based on the mean of the angular positions.

17. (Currently Amended) A Total Station apparatus according to claim 12, wherein the incremental track is comprised of a plurality of equally spaced and radially distributed

markings near ~~the~~an outer edge of the disk, and wherein the absolute track is comprised of markings that form a series of coded lines that include broad and narrow lines radially distributed inside the incremental track such that the broad lines divide the track into equally sized sections and within each section are two narrow data lines that carry information about absolute position.

18. (Currently Amended) A Total Station apparatus according to claim 12, further comprising a~~wherein the~~ processor for calculating the topographic data and~~includes a~~ controller for operating the automatic tracking servo-mechanism.

19.-20. (Cancelled)

21. (Currently Amended) A method of calculating an absolute position with an optical rotary encoder device comprising:

illuminating with a light source an incremental code track and an absolute code track formed on a disk;

imaging a segment of the incremental and absolute code tracks onto a first CCD or CMOS area array sensor for forming an imaged pattern of the code tracks, ~~wherein the segment is imaged onto~~said area array sensor comprising a pixel matrix having a plurality of rows;

reading a first detector line corresponding to a row in the pixel matrix comprising the imaged pattern of the incremental code track;

reading a second detector line corresponding to a row in the matrix comprising the imaged pattern of the absolute code track;

compensating for fluctuations in the code ~~tracks~~tracks, resulting from inaccurate mounting of the ~~disk~~disk, by selecting a suitable first and second detector line~~lines~~ ~~imaged by the first area array sensor~~ such that a period length of the imaged pattern of the code tracks along the detector lines remains constant;~~matches a period length used in position calculation;~~ and

calculating numerically the absolute position based on the light distribution of the imaged patterns of the incremental and absolute code tracks.

22. (Currently Amended) The method according to claim 21, wherein the incremental and absolute code tracks are imaged also onto~~imaging uses~~ a second CCD or CMOS area array sensor, where the first and second area array sensors are positioned 180 degrees apart with respect to the optical disk, such that the incremental and absolute code tracks are imaged~~read~~ at two different locations resulting in two different angular positions, and wherein the absolute position is based on the mean of the angular positions.

23. (Currently Amended) The method according to ~~claim 21~~ claim 22, wherein said light source and said first and second area array sensors are proximally located on a first side of the disk and a mirror located on a second side, whereby emitted light is reflected by the mirror through the disk to illuminate the code tracks for reception by the first and second area array sensors.

24. (Currently Amended) The method according to claim 21, wherein the compensating dynamically changes the detector line of the incremental track image when ~~the~~ a pattern period changes due to spatial movement of the disk, so that the detector line is shifted in order for a period length of the imaged pattern along said~~so that the detector line of the incremental track image to remain constant~~always includes an image with a constant pattern period.

25. (Currently Amended) The method according to claim 21, wherein the compensating includes altering ~~the~~ a numerical value of the pattern period used in a Fourier phase algorithm to match spatial frequency of fluctuating tracks.

26. (Original) The method according to claim 21, wherein at least a Field Programmable Gate Array (FPGA) performs at least a portion of the numerical calculations.

27. (Currently Amended) The method according to claim 21, wherein the incremental and absolute code tracks are imaged also onto~~imaging uses second~~, third and fourth CCD

or CMOS area array sensors, where the first through fourth area array sensors are positioned 90 degrees apart with respect to the disk, such that the incremental and absolute code tracks are read at four different locations.